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JET AGE PROBLEMS

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WITH JET TRANSPORT PLANES on order for all major U.S. airlines, civil aviation in this country is on the threshold of the jet age. Since last autumn domestic airlines and foreign air carriers serving the United States have signed contracts for some 200 Boeing and Douglas jet transports.[1] Before those planes can be put into widespread service, many problems raised by their prospective use will have to be put on the way to solution.

No one anticipates that all the answers will be forthcoming in the next two or three years. The automobile age dawned more than half a century ago, and neither this country, where the motor car made its greatest advances, nor any other country has caught up with the problems it introduced. Economic and social adjustment to the spreading use of the automobile is a continuing process of which the end is not in sight. So it probably will be with jet planes and all aviation. But the tremendous speed that characterizes jet aircraft is symbolic of the urgency attaching to preparations for the jet age.

The first jet service by an American air carrier probably will begin in December 1958, when Pan American World Airways expects to start using Boeing 707s on its transoceanic routes. The first domestic jet service is looked for in June 1959, when American Airlines plans coast-to-coast operations with the same type of plane. Even though commercial jets thus will not be flying here for another two or three years, many authorities fear the interval may not allow enough time to get ready.[2]

[1] The first U.S. airline commitment to buy jets reportedly was made last August by National Airlines, but that company did not actually put in its order for six Douglas DC-8s until early November. Meanwhile, Pan American World Airways had announced, Oct. 13, that it had placed orders for 25 DC-8s and 20 Boeing 707s. United Air Lines, which operates mainly within the United States, announced an order for 30 DC-8s on Oct. 25.

[2] No commercial jet transports have been in operation anywhere since the spring of 1954, when the British-made Comets were grounded following a series of crashes. However, British officials have forecast that an improved Comet will go into service ahead of the American jets.

Initiation of jet transport service will complicate already troublesome air traffic problems and generate new ones. Gill Robb Wilson, president of the Air Force Association, observed at a "jet age conference" sponsored by that organization in Washington, Feb. 3, that "Jet propulsion has multiplied the attendant annoyances of airpower, emphasized the obsolescence of current facilities, magnified the hazards of crowded airways, and imposed weighty economic considerations." [3]

Jets are not solely responsible for the problems that will beset air transportation in the years ahead, but their impending arrival has increased the pressure for solution of those problems. Government officials at all levels, as well as aircraft industry and airline executives, are confronted with the necessity of fitting into already overcrowded airways and airports not only the new jet planes, bigger and faster than any planes now in service, but also all the old and new propeller craft that will be flying then.[4] And they must devise some means of satisfactorily handling such problems as those raised by the noise involved in operation of jet planes.

Official Planning to Meet Needs of the Jet Age

A major step to meet the challenge of the jet age was taken by the federal government only ten days ago. A contract was awarded May 14 to three private institutions[5] for a study "to determine for the next two decades the requirements for those aviation facilities commonly used by all airspace users, both civil and military, including navigation aids, communications, air traffic control, airways and airports."

When the White House announced the project, it called it the "first step in the government's efforts to develop a comprehensive plan for meeting the requirements of the jet aircraft age." The study, costing an estimated $300,000, is to be paid for by the Defense and Commerce departments, but it will be carried out under the general supervision of President Eisenhower's Special Assistant for Aviation

[3] At the same conference Robert Aldrich, president of the Airport Operators Council, quoted an airline president to the following effect: "We are buying airplanes that haven't yet been fully designed, with millions of dollars we don't have, and we're going to operate them off airports that are too small in an air traffic control system that is too slow, and we must fill them with more passengers than we've ever carried before."

[4] U.S. airlines have ordered around 300 turbo-prop and piston-powered planes, for delivery in the next few years, in addition to the jets they have on order.

[5] Airborne Instruments Laboratory, Inc. of Mineola, N.Y., in cooperation with Cornell Aeronautical Laboratory, Inc. of Buffalo and the Aeronautical Research Foundation of Boston.

Facilities Planning, Edward P. Curtis, a vice president of the Eastman Kodak Company who had been chief of staff of the Strategic Air Force in World War II. Action leading to the projected study was initiated more than a year ago.

Taking note of "the rapid expansion of commercial air transportation, the introduction of vertical flight and jet aircraft, . . . [and] the increasing congestion of airspace," Rowland R. Hughes, then director of the Budget Bureau, in May 1955 appointed an "aviation facilities study group" to inquire into the need for an investigation of long-range aviation requirements.[6] That group, headed by William B. Harding, New York investment banker, submitted its report last Dec. 31.

The report, made public on Jan. 13, 1956, pointed out that "Much of our airspace is already overcrowded, and . . . in many important areas the development of airports, navigation aids, and especially . . . [the] air traffic control system, is lagging far behind both aeronautical development and the needs of our mobile population and . . . industry." Warning was given that risks of mid-air collisions had "reached critical proportions," and that the danger was "becoming greater as the increases in civil and military air traffic outpace the capabilities of . . . traffic control facilities." The report concluded that there was need for a "comprehensive study leading to a national plan for . . . aviation facilities . . . for the next 20 years."

President Eisenhower on Feb. 11 made Curtis his special assistant and asked him (1) to supervise a long-range study of the nation's requirements for aviation facilities; (2) to develop a comprehensive plan to meet such needs; and (3) to prepare legislative, budgetary, and other recommendations to implement the plan. The President wrote Curtis that he was requesting the study because "Rapid technical advances in aviation and the remarkable growth in the use of air transportation have confronted the nation with serious aviation facilities problems."

> Moreover, anticipated further increases in air traffic, the introduction of jet propulsion for civil as well as military aircraft, the advances being made in vertical flight, and the greater use of higher altitudes, all presage much heavier demands upon our facilities for navigation and traffic control. . . .

[6] The group defined "aviation facilities" as "airports, navigation aids, traffic control devices, and the communications that link them together."

> To delay the formulation of . . . [a comprehensive aviation facilities] plan is to invite further congestion of the airspace, needless hazard, economic loss, inconvenience to users, and possible impairment to the national security.

Another step in preparation for the jet age was taken early in March, when Civil Aeronautics Administrator Charles J. Lowen, Jr., announced establishment within C.A.A. of a separate Office of Air Traffic Control to deal with air traffic problems. Creation of a C.A.A. planning group, to work with other government agencies and industry on problems posed by the jets, followed on Apr. 20. The planning group has adopted as its initial task the job of looking for answers to a list of 100 questions. The questions were inspired in part by a conference of government, aircraft industry, and airport specialists, held under C.A.A. auspices in Washington last Jan. 11, to consider problems raised by the approach of jet airliners. Discussions at that meeting disclosed that those who will be involved in jet transport operations are concerned principally about air traffic control, airport facilities, and noise abatement.

Air Traffic Problems and Advent of Jets

CRITICAL CONGESTION of the airspace is one thing that is bothering the planners who are looking ahead to commercial jet operation. The seemingly boundless sky is already crowded with planes, and it will become even more congested as the volume of air traffic continues to grow. The amount of usable airspace is restricted by limitations of the air traffic control system and by requirements of activities other than normal flying.[7] But the tremendous growth of flying activity during the last few years, and the increase in plane speeds, are primarily responsible for the aerial traffic jam.

Aircraft arrivals and departures handled by C.A.A.-operated control towers rose from 11.9 million in 1946 to 19.5 million in 1955. In the past decade the total number

[7] Some 500 areas, aggregating about 400,000 square miles, are designated as "prohibited," "restricted," or "warning" areas, barred to regular civil and military aircraft. Such areas include artillery, bombing, and missile ranges, aircraft testing areas, atomic energy installations, etc.

of civil aircraft registered with the C.A.A. has grown from 81,000 to more than 92,000. Active aircraft—those having valid airworthiness certificates—have increased from about 54,000 in 1946 to around 60,000 at present. The C.A.A. expects a total of 100,000 registered, and 70,000 active, aircraft by 1960.

The fleet of the scheduled domestic airlines, which has almost doubled since 1946, now includes about 1,200 planes and is expected to total 1,600 by the end of the present decade. Transport operations, as measured by passenger-miles flown by scheduled domestic airlines, have more than tripled since 1946. Last year the regular air carriers flew a record of 19.9 billion passenger-miles, thus virtually attaining, five years ahead of time, the 20-billion total that C.A.A. had predicted for 1960.

Growth of the air transportation industry is a familiar fact, but the extent of "general aviation"—miscellaneous commercial and private flying—is often overlooked. General aviation operations, which include all civil flying except that of scheduled airlines and C.A.A. itself, involve more than 50 times as many planes as the operations of the airlines. Planes engaged in general aviation fly about two and one-half times as many aircraft-miles as those in airline service. Such flying in 1955 totaled 9.5 million hours and is expected to reach nearly 12 million hours by 1960.

The largest component in the general aviation field, and the one that has made the most spectacular advances, is business flying. It has been estimated that as many as 6,000 corporations have private planes, and that the company air fleet totals 22,000 aircraft. Planes used for company, farming, ranching, or personal business logged more than four million hours last year, as against one million hours in 1946.

Inadequacies of the Air Traffic Control System

To handle current and anticipated air traffic, an adequate traffic control system is a must, but as a recent C.A.A. report pointed out, "Today's system was built with the resources of yesterday and is not able to cope with the demands of traffic today." [8] C.A.A. Administrator Lowen

[8] Civil Aeronautics Administration, *Federal Airway Plan, Fiscal Years 1957-1961*, December 1955, p. 18. The report, outlining a five-year plan for expansion of air navigation and traffic control facilities, was submitted to congressional appropriations committees in January but not released until Apr. 27, 1956.

has called air traffic control "our No. 1 problem." [9] The Harding committee noted that since 1950 there had been more than 65 mid-air collisions of civil aircraft, which had resulted in heavy loss of life and equipment, although no single collision involved two large transports. It directed attention to the fact that there are "on the average, four reported near-collisions involving the airlines daily." [10]

Air traffic consists of VFR flights, made under Visual Flight Rules, and IFR flights, made under Instrument Flight Rules. "Flying IFR" is necessary when weather conditions between origin and destination are such that a pilot cannot navigate by ground observation and cannot see at least three miles ahead. VFR flights may be made without notice, but IFR flights require filing of an instrument flight plan with air traffic control authorities. The pilot of every IFR flight has to maintain contact with a C.A.A. air traffic control facility either directly or, in the case of scheduled airline planes, indirectly through company communications facilities. The traffic control authority may order the pilot to change the plane's altitude or course in order to keep it away from other aircraft. Planes flying under IFR conditions are surrounded by a block of protective airspace, which varies in size with the type of plane and existing conditions, but which is intended to provide a separation of at least ten minutes between planes.[11]

Aircraft flying IFR report their positions at specified points by radio, directly or indirectly, to a controller at one of the 26 centers which control traffic along the established C.A.A. airways. When a plane reports that it has passed over a certain ground station, or "fix," the controller posts its position on a flight progress board. When the plane has moved through the zone for which one controller is responsible, he passes it along to a controller beside him who is responsible for the adjoining zone, and so on through perhaps a half-dozen men controlling the area over which the plane flies; finally, the aircraft is turned over for landing instructions to the control tower.

[9] Speech before Fourth Annual Air Safety Forum, Air Line Pilots Association, Chicago, Mar. 7, 1956.

[10] According to Jerome Lederer, managing director of the Flight Safety Foundation: "The minimum cost of a major airline accident is about $2 million. The minimum cost of a major jet accident will be about $6 million and may easily go as high as $10 million, exclusive of damage to property or injury to people on the ground."—Speech before Air Force Association's jet age conference, Washington, Feb. 4, 1956, reprinted in *Air Force*, March 1956, p. 88.

[11] Present standards require that the block of protective airspace for a plane traveling 360 miles an hour be 10 miles wide, 1,000 to 2,000 feet thick, and 60 to 90 miles long, according to altitude and available navigation aids.

"Fix postings," which constitute a measure of the use of airways and airway facilities, increased from 8.8 million in 1946 to an estimated 20.6 million last year; they are expected to reach 29 million by 1960. The system of manual fix posting, introduced about 1935, is now—the Harding committee asserted—"obsolescent" and "far too slow and too cumbersome to handle today's high-speed, high-density air traffic."

Air traffic control is complicated not only by growth in the number and speed of planes but also by the variety of aircraft in use and the differences in performance factors. "Maximum and minimum speed limits are largely built into aircraft rather than legislated as for automobiles. The swift and the slow must be merged into a smooth combined operation without impeding the traffic flow." [12] Controlled traffic moves at speeds ranging from less than 100 to more than 300 miles an hour. Within the next few years traffic controllers will have to deal with everything from helicopters—in increased numbers—hovering at zero speed and jet transports zooming along at 500 to 600 miles an hour.

Rising Need for En Route Control of Air Traffic

"It is the high-speed plane, especially," Administrator Lowen told a New York audience last January, "which compels us to accelerate the improvement of our air traffic control system, for if two jets approach each other, the closure rate of more than 1,000 miles an hour demands the most precise and instantaneous methods of separation." Requiring a ten-minute separation for jet aircraft would restrict traffic to an impossible extent. It has been estimated that such an arrangement would permit only two 600-mile-an-hour jets to fly between New York and Washington along a single airway. Moreover, it has been said that even now, in bad weather, only 3,000 planes can be fitted into the entire U.S. airspace.

Eventually, all flying, in good and bad weather, will have to be under instrument control. But the present control system could not handle all the traffic that operates in good weather. Any attempt to control all traffic at all times with the present C.A.A. equipment, the Harding committee said, "would be chaotic." What is needed is more radar—in sufficient quantity for the controller to

[12] Civil Aeronautics Administration, *op. cit.*, p. 1.

see the traffic under control instead of visualizing it from manually posted reports.

The C.A.A. has been using radar for a number of years, but only at a comparatively few airports and mainly for directing short-range and final approach operations. It employs airport surveillance radars to detect aircraft within 50 to 60 miles of an airfield and to expedite the flow of traffic.[13] Precision approach radars are employed to help guide pilots toward the runway. At present, however, the C.A.A. operates only about 30 surveillance and around a dozen approach radars. Its long-range radar at New York is the only modern one in C.A.A. service capable of supplying information about aircraft en route comparable to the information which can be obtained about planes that are in the vicinity of certain airports. It has been estimated that long-range radar could cut the present ten-minute separation between planes down to five miles.

In a foreword to the plan for expansion of the airway system which C.A.A. has submitted to Congress, Administrator Lowen wrote that even while the capacity of the traffic control system was being "overtaxed by instrument operations alone," the need for "en route control of traffic in good weather" was becoming "increasingly apparent." Lowen ascribed the need to the great increase in traffic volume, which creates congestion, and to higher aircraft speeds, which make more difficult the avoidance of collision by sight alone. Therefore, he concluded, the present traffic control system must be rapidly expanded, "not only . . . to make up deficiencies in its present service . . . in bad weather, but also to progressively embrace those good-weather operations which need its protection."

Deficiencies in Runways and Passenger Facilities

Many experts question whether today's airports are any more adequate than the air traffic control system to handle tomorrow's planes. Growth in aviation activity has stretched the capacity of many airports to the limit. "Civil airport development has lagged frighteningly behind increases in aircraft speeds and weights and [increases in] traffic."[14] The jets and other new aircraft now on order

[13] The equipment provides such precise position information that it makes possible only a three-mile minimum separation between planes operating at the same altitude.

[14] C. N. Sayen, president, Air Line Pilots Association, quoted in *Wall Street Journal*, Feb. 1, 1956.

will make far greater demands on airport facilities than planes currently in service. Among improvements required at many airports are longer and stronger runways, better lighting, and larger passenger and baggage-handling facilities.

The ability of existing runways to accommodate jet transports has been debated ever since the first orders for the new aircraft were announced. The discussion most likely will continue until the size and performance characteristics of the new planes are better established. Robert Aldrich, president of the Airport Operators Council, said recently: "We are under the impression at the moment that we have no airports in the United States, with the exception of Honolulu, on which, generally speaking, the jet . . . transport can be operated." [15] Others have contended that only seven U.S. airports will be able to handle fully loaded jet airliners.[16] A spokesman for the Air Line Pilots Association told a Cleveland audience last month that many runways were "marginal" even for current aircraft and might prove "unusable" for jets.[17]

The problem of runway length is complicated by the fact that the higher the elevation of the airport and the hotter the day, the longer the runway must be. That is because thin, hot air provides less support for take-off than dense, cold air. Present C.A.A. standards require that the length of a runway be increased 7 per cent for each 1,000 feet above sea level and 0.5 per cent for each degree that the mean temperature of the hottest month of the year exceeds 59 degrees.

At the jet aircraft meeting called by the C.A.A. in Washington last January, representatives of both the Boeing and Douglas companies said that fully loaded jet transports would require about 9,500 feet for take-off at sea level and standard temperature.[18] Boeing representatives agree that some runways from which fully loaded jets

[15] Remarks at Air Force Association's jet age conference, Washington, Feb. 4, 1956, reprinted in *Air Force*, March 1956, p. 79.

[16] Baltimore-Friendship, Boston-Logan, Detroit-Wayne Major, New York-Idlewild, Portland-Municipal, San Diego-Lindbergh, and San Francisco-Municipal. Estimates of the number of cities likely to have jet service in the first years of the jet age range from 12 to 40 or 50.

[17] Theodore G. Linnert, head of A.L.P.A.'s engineering and air safety department, speech before American Association of Airport Executives, Cleveland, Apr. 25, 1956.

[18] Among airports with the longest runways are Boston, which has a 10,012-foot runway, the effective length of which is 9,185 feet when corrected; New York's Idlewild, 9,422, corrected to 8,724; San Francisco, 8,870, corrected to 8,612; and Chicago's O'Hare, 8,000, corrected to 6,838.—Figures cited by C.A.A. Administrator Charles J. Lowen, Jr., in *Air Force*, March 1956, p. 80.

will take off on transoceanic hops may have to be lengthened, but they maintain that the major American airports are adequate for domestic flights, even for transcontinental hops. Donald Douglas, president of the Douglas Aircraft Company, has said that "All the airports now being used for transcontinental service will be able to handle the DC-8 nicely."[19] Administrator Lowen told the Air Force Association in Washington on Feb. 4 that "It seems fairly clear . . . that while our major airports will be able to handle domestic jet operations, they may run into trouble when it comes to intercontinental flights."

The advent of large jet transports, expected to carry 100 to 150 passengers as against 80 to 90 in the largest planes today, will put a heavy burden on already overloaded passenger and baggage-handling facilities at airports. Cynics have questioned the utility of speeding passengers across the country in a little over four hours if it takes them another hour to get their baggage.

Ticket counters at present are not set up to permit checking-in of 100 to 150 passengers. Louis R. Inwood, director of aviation of the Philadelphia airport, said last winter that counter and related facilities already were taxed to capacity by the passenger volume generated by 88-seat airliners now in service. He asserted that there was "not an airport in the United States" with enough counter space to handle the number of passengers that jet liners will carry.

Noise Problem and Damage From Jet Shock Waves

The noise of jet engines poses another problem for airline, aircraft company, and airport officials. Even the most enthusiastic champions of jets concede that they are noisier at take-off than piston-engine airliners, but there is considerable disagreement about how much noisier and about what effect the noise may have on persons and structures within its range.

The noise made at take-off by a four-engine DC-7, fastest of today's airliners, measures about 100 decibels of sound, in contrast to the 140 decibels produced by a B-52 jet bomber. However, manufacturers maintain that military jets are much noisier than civilian jets, because the military planes use after-burners for added power.

[19] Interview in *Parade*, Apr. 22, 1956, p. 9.

Airport and community officials have warned that excessively noisy jets will not be tolerated by persons living in the neighborhood of plane operations. The Airport Operators Council, which represents 40 of the largest civil airports in the country, advised persons attending last winter's C.A.A. jet conference that "It would be just as useless to design . . . transport planes that cannot be operated into and out of civil airports because of excessive noise as it would be to design planes that cannot fly." Jets without noise-reducing devices, the A.O.C. said, "will not be acceptable to the public."

The Port of New York Authority in 1951 prohibited jet operations without special permission at airports under its jurisdiction; it recently refused to let either the Boeing 707 prototype or the British Comet III jet transport, which was on a round-the-world test flight, land at Idlewild. Rep. Albert B. Morano (R-Conn.) disclosed, Jan. 30, that the House Armed Services Committee had received many complaints that shock waves set up by military jet aircraft were causing ceilings and walls of dwellings to crack.

The Federal Housing Administration became worried recently about the impact of the jet age on the value of buildings which it has insured or may insure near airports. F.H.A. Commissioner Norman P. Mason called a meeting of airline and aircraft industry officials last February to consider whether the noise nuisance and other disadvantageous aspects of jet operations warranted revision of F.H.A. mortgage insurance policies. Mason reported that he had been assured by experts that the noise of jet transports would be "comparable" to that of piston-powered aircraft and that the airport of the future would not be "too much different" from that of the present.

Preparations for Use of Jet Transports

TO COPE with problems of airspace congestion and air traffic control in the jet age, many experts assert, a completely new control system will be needed. They maintain that a combination of long-range radar and electronic brains will be required to fly most airliners because the volume

of traffic and the speed of planes will not allow time for pilots to make decisions.[20] Such push-button control systems may one day come into use, but in the meantime C.A.A. is planning to increase the capacity of the airways by utilizing equipment now available.

The C.A.A. on Apr. 27 made public a five-year plan designed to provide a "modernized . . . air traffic control system . . . to keep pace with the requirements of the jet age." The plan aims to give the controller "radar eyes" as well as his present "radio ears." Specialists have estimated that, when the program has been carried out fully, the capacity of the air traffic control system will be four times as great as at present.

The plan calls for installation, between July 1, 1956, and July 1, 1961, of 69 long-range radars; short-range airport surveillance radars at 44 additional airports; airport surface detection radars at 20 places; and radar beacons at 134 locations.[21] Other installations called for include 40 additional airport traffic control towers, 383 VOR/DMEs,[22] 28 additional instrument landing systems, and 187 lighting systems of various types.

Cost of the new facilities is estimated at $246.2 million. C.A.A. asked Congress for an initial appropriation of $40 million. The House approved $37.5 million on May 2, but the Senate has not yet acted. C.A.A. had started earlier to build the country's first all-radar airway along the heavily traveled Boston-Norfolk route. When that is completed, within the next two years, traffic controllers will be able to keep in contact with planes along the entire route by radar rather than radio.

Possibility of Utilizing Military Radar Facilities

C.A.A. has indicated that it will utilize military radar installations wherever possible. Not all Air Defense Com-

[20] According to the Harding committee report, it takes about seven seconds for a pilot to change course after he has seen an object that must be avoided. The report added: "It is impossible for a pilot to fly a high-speed modern airplane effectively without almost continuous reference to his cockpit instruments. Hence, under the best conditions, the pilot . . . may not be looking out of his airplane when a mid-air collision is imminent. Furthermore, he can see only a small per cent of the sky around him from his cockpit and may not see crossing, overtaking, or descending aircraft."

[21] The beacons make up the so-called secondary radar system, which includes radar transmitting and receiving equipment on the ground and in the aircraft. Operation of secondary radar is dependent on transmission of radar replies from aircraft, as contrasted with primary radar which relies on reflection of ground-transmitted radar signals from the surface of aircraft.

[22] Very high frequency omni-directional radio ranges with associated distance-measuring equipment.

mand radars are suitable for joint use, but such use where feasible would improve air traffic control and cut down the number of new radars needed for civilian flying. An inquiry into the possibility of using A.D.C. radar for control of civil traffic was announced jointly by C.A.A. and A.D.C. on Feb. 20. The C.A.A. will test a tie-in of certain military radar facilities in Indiana with the Indianapolis traffic control center. The study will be supplemented by further joint activity in the Boston area.

The C.A.A. is studying also the Defense Department's SAGE (Semi-Automatic Ground Environment) system, a giant electronic system designed to help detect and intercept enemy aircraft, in order to determine whether it can be adapted for civilian air traffic control. It is understood that SAGE correlates information on enemy aircraft from radar outposts, selects the proper counter-weapon, and directs it to the target. Several authorities have maintained that if SAGE can keep track of enemy bombers, it can be modified to do double duty directing peaceful airliners as well.

It is contended, moreover, that not only could SAGE help bring automation to the airways and make possible the handling of a dozen times as many aircraft as the present system, but also that it could save the government millions of dollars. The Harding committee asserted that if the C.A.A. and SAGE systems were "not urgently developed into a common system, there will be wasteful duplication in time and tax money, with the result that the Civil Aeronautics Administration will have spent about $370 million for the installation of . . . [its] own system . . . [which will have] about one-tenth . . . the capabilities of the . . . system being installed by the military at a total cost of $3 billion."

C.A.A. Administrator Lowen has declared, however, that SAGE "offers no immediate answer to a pilot's prayer."

> First of all, SAGE is designed primarily to direct an individual fighter . . . toward an individual enemy bomber. It will require extensive revision to accomplish the air traffic control mission of directing a considerable number of planes away from one another. Secondly, there is in existence only one SAGE setup, the prototype in the Boston area. It must be produced, installed, and debugged at all the required military locations before the necessary steps can be taken to make it available for civil use.[23]

[23] Speech before Fourth Annual Air Safety Forum, Air Line Pilots Association, Chicago, Mar. 7, 1956.

In the meantime, C.A.A. has ordered a conventional electronic computer for its Indianapolis traffic control center. It will use the data-processing machine to study the possibility of mechanizing the clerical duties of the controller and also to gain experience in application of computers to traffic control operations.

Steps to Modernize and Expand Airport Facilities

In preparation for jet age traffic, airport authorities are planning to spend in the coming four years about half a billion dollars—more than twice what they have spent in the last eight years—to improve their airfields. Congress last year authorized the C.A.A. to enter into contracts with states and cities for grants totaling $232 million during the four years ending June 30, 1959, subject to matching on a 50-50 basis. Local sponsors already have listed funds totaling $247 million as available to match federal grants.

The new federal payments were authorized by an amendment to the Federal Airport Act of 1946, under which the federal government has made grants on a 50-50 matching basis to local sponsors for "establishment of a nation-wide system of public airports adequate to meet the present and future needs of civil aeronautics." The 1946 act authorized grants of around $500 million, but only about one-half that amount has been actually appropriated. For the fiscal year beginning July 1, 1956, the House has approved an appropriation of $30 million for airport grants—about $10 million more than was voted last year—but Senate action is still awaited. During the fiscal year now drawing to a close, the federal government has programmed about $59 million for 524 airport projects.

With that money and their own funds, airport authorities are putting in new runways and improving old ones, acquiring land for clear zones at the end of runways, building additional taxi strips, and enlarging terminal facilities. Administrator Lowen has said that C.A.A. is in a "waiting period" on the problems of runway length and strength, but that it is reviewing its standards on airport design and construction. The C.A.A. expects within a few weeks to have the loan of a B-47 jet bomber, which it will fly into various airports around the country. It plans eventually to obtain a civil jet transport to operate over some such route as Seattle-Denver-Chicago-Washington. The agency

hopes that the experimental jet flights will supply information on airport requirements and give ground crews training on special handling problems that may arise in jet operations.

Airport and local government spokesmen at the C.A.A. jet meeting in Washington last January gave notice that airports were in competition with schools, roads, and other needs for local funds, and that local support for airfield improvements would become harder and harder to get. Mayor William B. Hartsfield of Atlanta said that cities had been "madly raising funds, lengthening runways, and enlarging airports" for 15 years; he suggested that the time had come for aircraft manufacturers to design planes to fit existing facilities. Administrator Lowen, in his Philadelphia speech on Apr. 17, agreed that "We cannot go on year after year expanding all our airport facilities." It was his opinion that "We have a right to expect a kind of aircraft to be developed that will be more economical of facilities on the ground."

Whether such pleas ultimately will be honored with respect to runway length remains to be seen,[24] but the manufacturers of the jets now on order have embodied in those planes certain features which suggest that they have been mindful of runway strength. The craft will have dual tandem landing gear to distribute load and lighten the impact on runways. They will have also jet reverse-thrust mechanisms to slow the planes after landing.

Research on Reduction of the Noise of Jet Engines

Aircraft manufacturers and the military services are working on the problem of muffling the noise of jet engines. Both the Boeing and Douglas jets are to be equipped with silencers or suppressors to cut down their roar. A Douglas spokesman said a few months ago that his company had spent more than $200,000 on the noise problem and was making progress. Boeing was reported to have nearly licked the problem on the lower-powered version of its jet. The company plans to conduct early flight tests of a noise-suppression device—a corrugated nozzle attached to the rear of the jet engine—that has proved promising in ground tests.

[24] Convair Division of General Dynamics Corporation announced Apr. 11 that it had developed a 600-mile-an-hour medium-range jet transport that could take off from and land on runways only 5,000 feet long.

Gen. Nathan F. Twining, Air Force Chief of Staff, said at the Air Force Association's conference on jet problems last February that "Noise is just something we are going to have to live with." But William Littlewood, vice president of American Airlines and chairman of the subcommittee on aircraft noise of the National Advisory Committee for Aeronautics, responded that "We refuse to accept the edict that nothing can be done, that people will just have to get used to it." Spokesmen for the various air lines that have purchased jets have insisted that the new planes will be only a little, if any, noisier than conventional aircraft. Some scientists have stated that the noise of jet engines will not cause mechanical damage to the human body.[25]

One possible means of combating the noise problem is to substitute for the regular jet engine the so-called by-pass engine, which diverts some of the air inhaled by jets around the combustion chamber. The by-pass design is said to make the engine less noisy and more efficient than the regular turbo-jet. Trans-Canada Air Lines announced May 9 that it had ordered Rolls-Royce Conway by-pass engines for the DC-8s it plans to put into service.

[25] Horace O. Parrack, technical director and coordinator, noise and vibration control, Air Research and Development Command, said in a speech before the Institute of Aeronautical Sciences in New York, Jan. 26, that virtually nothing was known about the psychological effects of engine roar, but he added that persons outside an air base would not suffer mechanical damage to the body, temporary loss of hearing, or nausea.